

PVsyst - Simulation report

Grid-Connected System

Project: Bank Albilad-Parking

Variant: Bank Albilad tower-25 years

No 3D scene defined, no shadings

System power: 51.0 kWp

Al Mu'tamarāt - Saudi Arabia



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Project summary			
Geographical Site	Situation		Project settings
Al Mu'tamarāt	Latitude	24.68 °N	Albedo
Saudi Arabia	Longitude	46.69 °E	0.20
	Altitude	602 m	
	Time zone	UTC+3	
Weather data			
Al Mu'tamarāt			
Meteonorm 8.1 (1998-2002), Sat=28% - Synthetic			

System summary			
Grid-Connected System			No 3D scene defined, no shadings
Simulation for year no 1			
PV Field Orientation	Near Shadings		User's needs
Fixed planes 2 orientations	No Shadings		Unlimited load (grid)
Tilts/azimuths 5 / 62 °			
5 / 29 °			
System information			
PV Array	Inverters		
Nb. of modules	Nb. of units		1 unit
Pnom total	Pnom total		40.0 kWac
	Pnom ratio		1.275

Results summary				
Produced Energy	97057 kWh/year	Specific production	1903 kWh/kWp/year	Perf. Ratio PR

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General parameters			
Grid-Connected System		No 3D scene defined, no shadings	
PV Field Orientation		Sheds configuration	Models used
Orientation		No 3D scene defined	Transposition Perez
Fixed planes	2 orientations		Diffuse Perez, Meteonorm
Tilts/azimuths	5 / 62 ° 5 / 29 °		Circumsolar separate
Horizon		Near Shadings	User's needs
Free Horizon		No Shadings	Unlimited load (grid)
PV Array Characteristics			
PV module		Inverter	
Manufacturer	Astronergy	Manufacturer	Huawei Technologies
Model	CHSM66RN(DG)F-BH-600 (Custom parameters definition)	Model	SUN2000-40KTL-M3-400V (Original PVsyst database)
Unit Nom. Power	600 Wp	Unit Nom. Power	40.0 kWac
Number of PV modules	85 units	Number of inverters	1 unit
Nominal (STC)	51.0 kWp	Total power	40.0 kWac
Array #1 - PV Array			
Orientation	#1		
Tilt/Azimuth	5/62 °		
Number of PV modules	30 units	Number of inverters	1 * MPPT 41% 0.4 unit
Nominal (STC)	18.00 kWp	Total power	16.4 kWac
Modules	2 string x 15 In series		
At operating cond. (50°C)		Operating voltage	200-1000 V
Pmpp	16.77 kWp	Max. power (=>40°C)	44.0 kWac
U mpp	557 V	Pnom ratio (DC:AC)	1.10
I mpp	30 A		
Array #2 - Sub-array #2			
Orientation	#1		
Tilt/Azimuth	5/62 °		
Number of PV modules	14 units	Number of inverters	1 * MPPT 15% 0.1 unit
Nominal (STC)	8.40 kWp	Total power	6.0 kWac
Modules	1 strings x 14 In series		
At operating cond. (50°C)		Operating voltage	200-1000 V
Pmpp	7.82 kWp	Max. power (=>40°C)	44.0 kWac
U mpp	520 V	Pnom ratio (DC:AC)	1.40
I mpp	15 A		
Array #3 - Sub-array #3			
Orientation	#2		
Tilt/Azimuth	5/29 °		
Number of PV modules	26 units	Number of inverters	1 * MPPT 28% 0.3 unit
Nominal (STC)	15.60 kWp	Total power	11.1 kWac
Modules	2 string x 13 In series		
At operating cond. (50°C)		Operating voltage	200-1000 V
Pmpp	14.53 kWp	Max. power (=>40°C)	44.0 kWac
U mpp	483 V	Pnom ratio (DC:AC)	1.40
I mpp	30 A		



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PV Array Characteristics

Array #4 - Sub-array #4

Orientation	#2	Number of inverters	1 * MPPT 16% 0.2 unit
Tilt/Azimuth	5/29 °	Total power	6.4 kWac
Number of PV modules	15 units	Operating voltage	200-1000 V
Nominal (STC)	9.00 kWp	Max. power ($\geq 40^{\circ}\text{C}$)	44.0 kWac
Modules	1 strings x 15 In series	Pnom ratio (DC:AC)	1.40
At operating cond. (50°C)			
Pmpp	8.38 kWp	Total inverter power	
U mpp	557 V	Total power	40 kWac
I mpp	15 A	Number of inverters	1 unit
Total PV power		Pnom ratio	1.27
Nominal (STC)	51 kWp	Power sharing defined	
Total	85 modules		
Module area	230 m ²		

Array losses

Array Soiling Losses

Loss Fraction	4.0 %	Thermal Loss factor	LID - Light Induced Degradation
		Module temperature according to irradiance	Loss Fraction
		Uc (const)	0.6 %

Uc (const)

29.0 W/m²K

Uv (wind)

0.0 W/m²K/m/s

Module Quality Loss

Loss Fraction	0.0 %	Module average degradation	
		Year no	1
		Loss factor	0.4 %/year
		Mismatch due to degradation	

Ump RMS dispersion

0.4 %/year

Vmmp RMS dispersion

0.4 %/year

Module mismatch losses

Array #1 - PV Array

Loss Fraction	1.0 % at MPP
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Array #2 - Sub-array #2

Loss Fraction	1.0 % at MPP
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Array #3 - Sub-array #3

Loss Fraction	1.0 % at MPP
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Array #4 - Sub-array #4

Loss Fraction	1.0 % at MPP
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IAM loss factor

Incidence effect (IAM): User defined profile

0°	40°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	1.000	1.000	0.984	0.949	0.830	0.000

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DC wiring losses

Global wiring resistance	10 mΩ
Loss Fraction	1.0 % at STC

Array #1 - PV Array

Global array res.	201 mΩ
Loss Fraction	1.0 % at STC

Array #3 - Sub-array #3

Global array res.	174 mΩ
Loss Fraction	1.0 % at STC

Array #2 - Sub-array #2

Global array res.	375 mΩ
Loss Fraction	1.0 % at STC

Array #4 - Sub-array #4

Global array res.	402 mΩ
Loss Fraction	1.0 % at STC

System losses**Unavailability of the system**

Time fraction	2.0 %
	7.3 days, 3 periods



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Main results

System Production

Produced Energy 97057 kWh/year

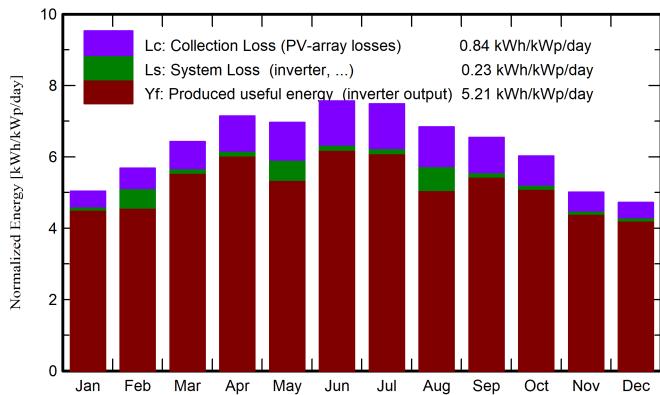
Specific production

1903 kWh/kWp/year

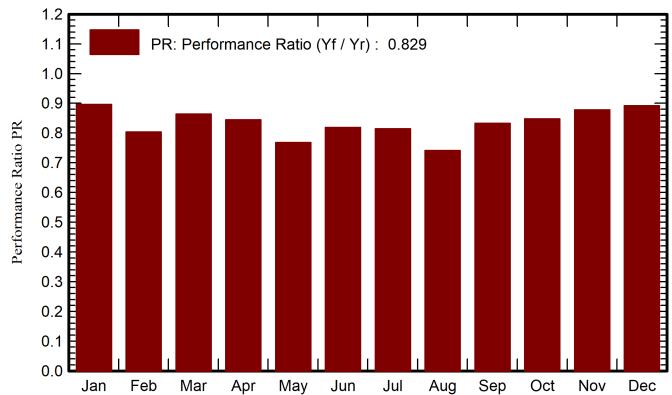
Perf. Ratio PR

82.90 %

Normalized productions (per installed kWp)



Performance Ratio PR

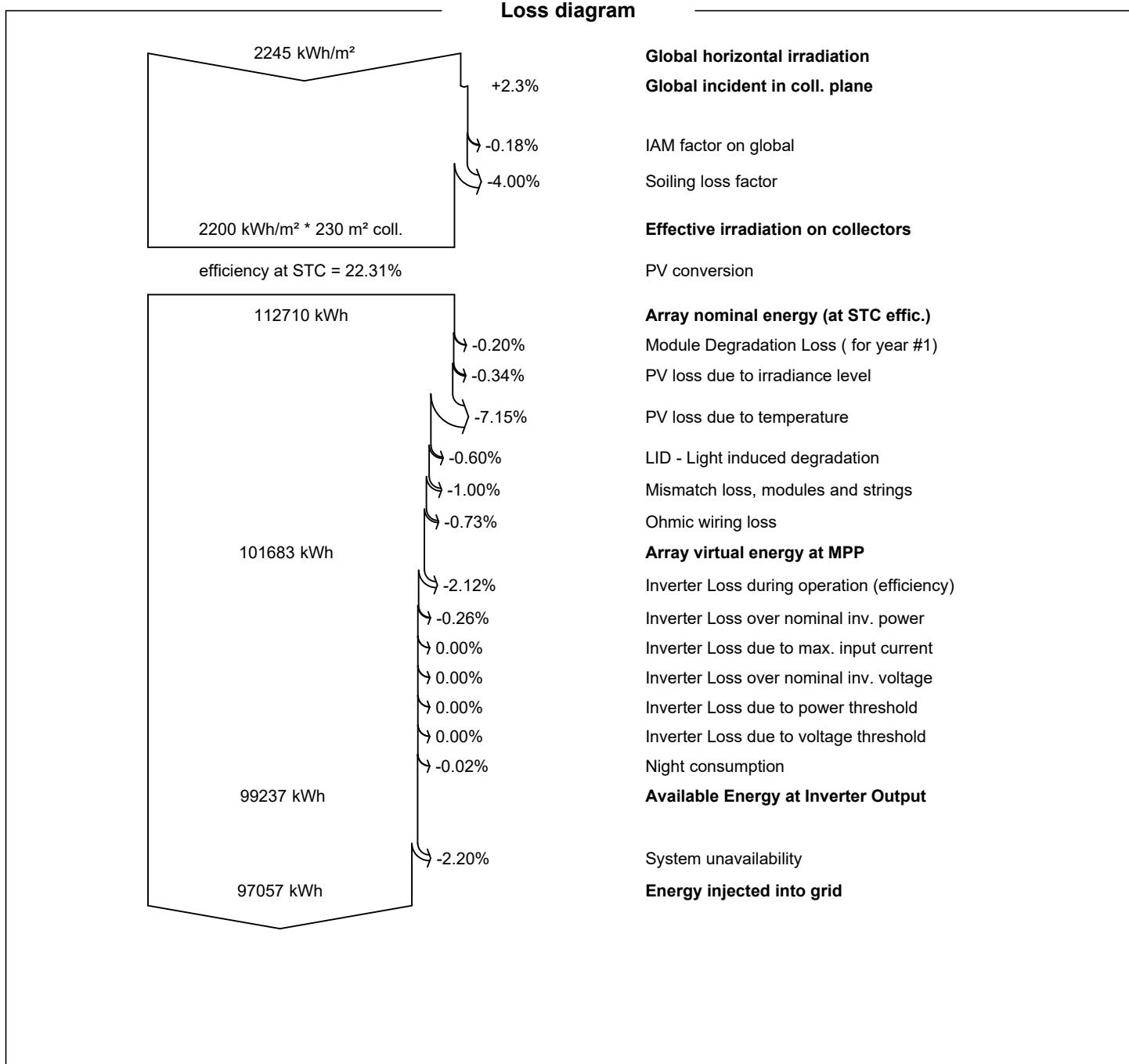


Balances and main results

	GlobHor kWh/m ²	DiffHor kWh/m ²	T_Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray kWh	E_Grid kWh	PR ratio
January	147.0	26.14	14.73	156.2	149.6	7288	7144	0.897
February	153.0	50.40	18.07	159.1	152.5	7310	6526	0.804
March	194.2	63.21	22.88	199.2	191.0	8972	8778	0.864
April	211.9	77.10	27.71	214.3	205.3	9432	9225	0.844
May	216.1	88.68	34.20	216.1	207.1	9354	8460	0.768
June	227.9	91.31	36.27	227.0	217.6	9700	9481	0.819
July	232.7	82.07	37.84	232.1	222.6	9864	9642	0.814
August	210.9	87.33	37.99	212.0	203.1	9072	8010	0.741
September	192.8	61.77	34.13	196.2	188.0	8519	8331	0.832
October	179.8	42.06	29.52	186.6	178.8	8249	8070	0.848
November	141.8	35.35	21.33	150.3	144.0	6866	6726	0.878
December	136.8	26.83	16.58	146.4	140.2	6798	6664	0.892
Year	2245.0	732.25	27.66	2295.7	2200.0	101424	97057	0.829

Legends

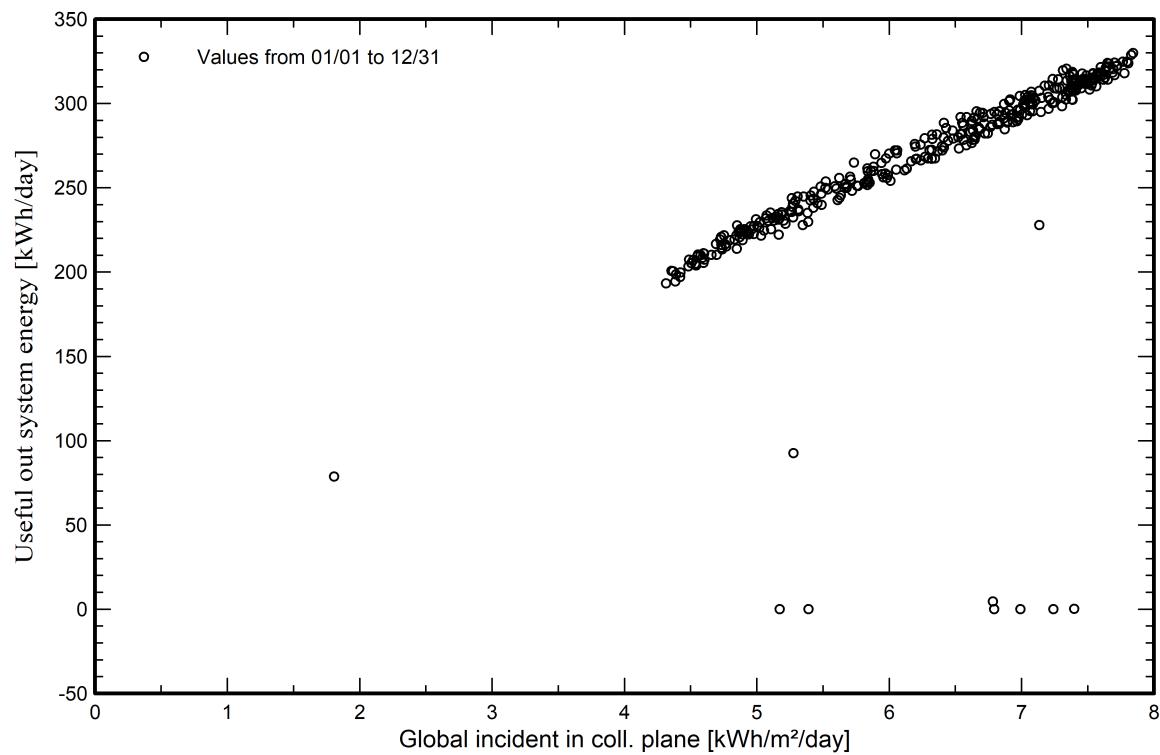
GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		



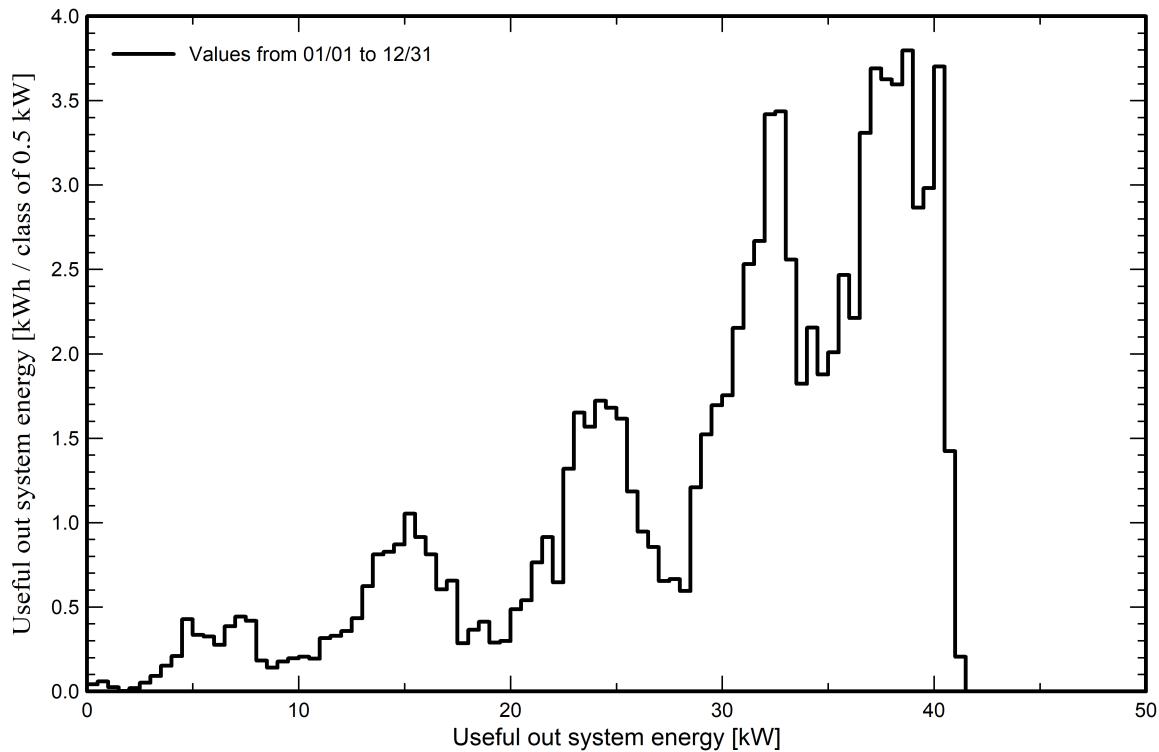


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



**Aging Tool****Aging Parameters**

Time span of simulation 25 years

Module average degradation

Loss factor 0.4 %/year

Mismatch due to degradation

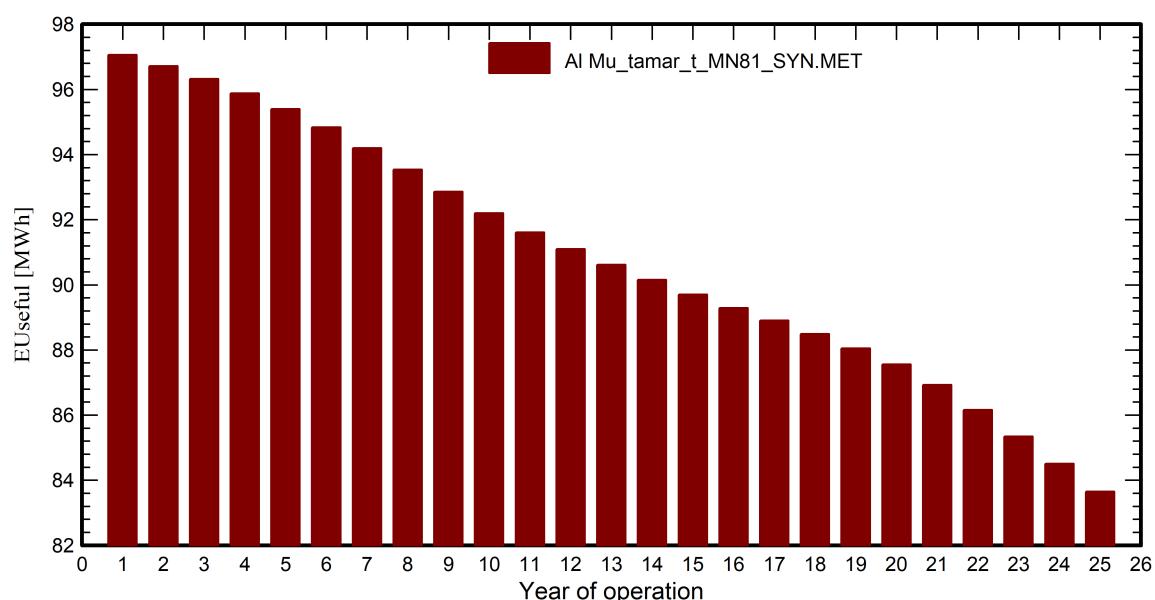
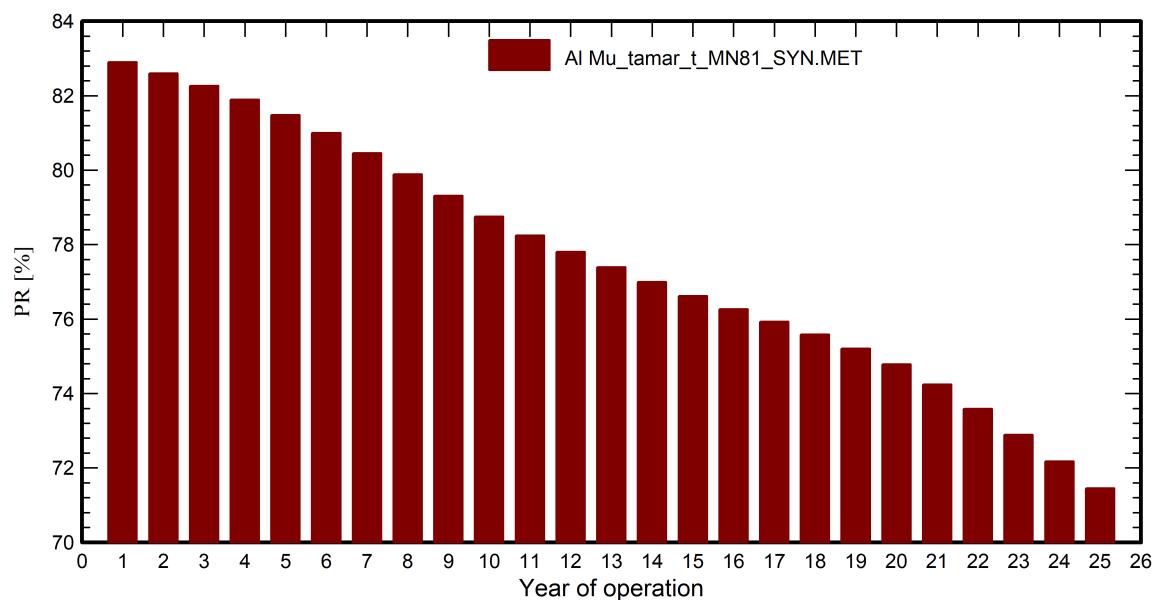
Imp RMS dispersion 0.4 %/year

Vmp RMS dispersion 0.4 %/year

Weather data used in the simulation

Al Mu_tamar_t MN81 SYN

Years reference year

Useful out system energy**Performance Ratio**

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Aging Tool**Aging Parameters**

Time span of simulation 25 years

Module average degradation

Loss factor 0.4 %/year

Mismatch due to degradation

Imp RMS dispersion 0.4 %/year

Vmp RMS dispersion 0.4 %/year

Weather data used in the simulation

Al Mu tamar t MN81 SYN

Years reference year

Year	EUUseful	PR	PR loss
	MWh	%	%
1	97.06	82.90	-0.18
2	96.71	82.60	-0.53
3	96.32	82.27	-0.94
4	95.88	81.89	-1.39
5	95.40	81.48	-1.89
6	94.83	81.00	-2.47
7	94.19	80.45	-3.12
8	93.53	79.89	-3.80
9	92.86	79.31	-4.49
10	92.20	78.75	-5.17
11	91.61	78.25	-5.78
12	91.10	77.81	-6.31
13	90.61	77.39	-6.81
14	90.15	77.00	-7.28
15	89.70	76.62	-7.74
16	89.29	76.26	-8.17
17	88.90	75.93	-8.57
18	88.49	75.58	-8.99
19	88.05	75.20	-9.44
20	87.55	74.78	-9.95
21	86.92	74.24	-10.60
22	86.16	73.59	-11.39
23	85.34	72.89	-12.22
24	84.50	72.18	-13.09
25	83.65	71.45	-13.96



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Weather data

Source Meteonorm 8.1 (1998-2002), Sat=28%
Kind TMY, multi-year

Year-to-year variability(Variance) 3.0 %

Specified Deviation

Climate change 0.0 %

Global variability (weather data + system)

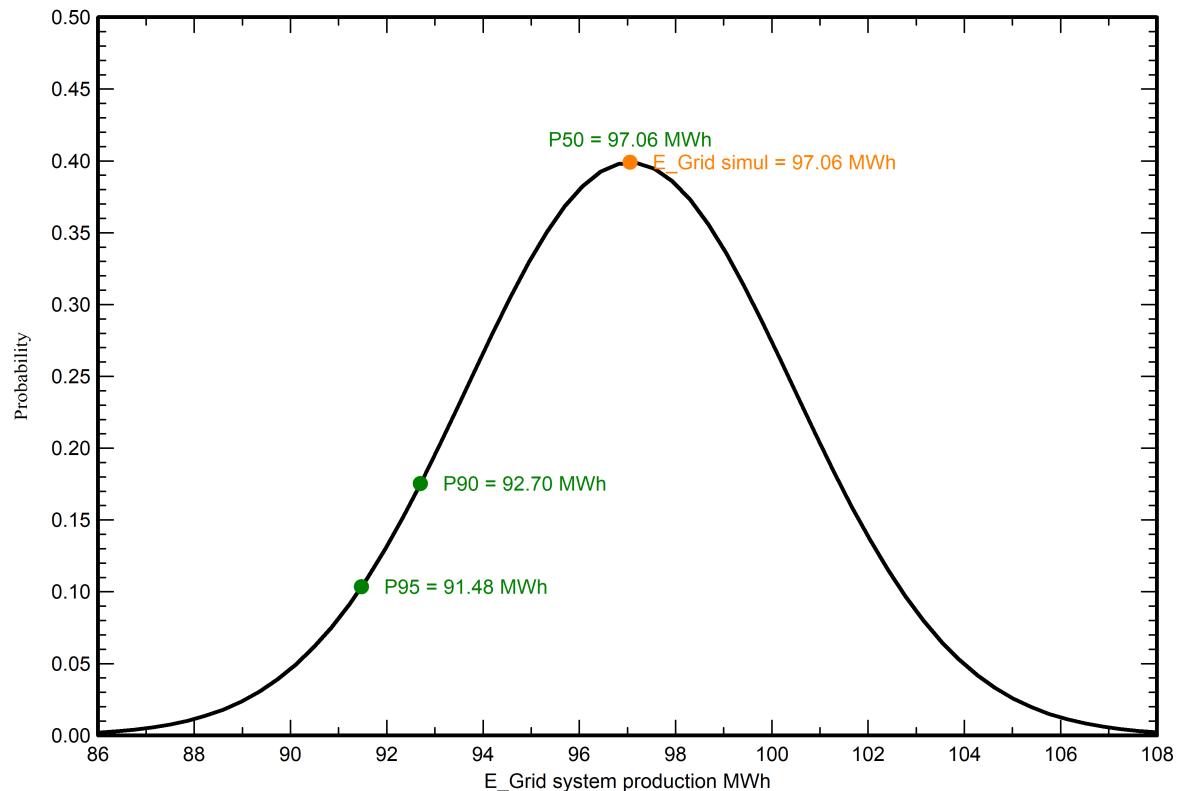
Variability (Quadratic sum) 3.5 %

Simulation and parameters uncertainties

PV module modelling/parameters 1.0 %
Inverter efficiency uncertainty 0.5 %
Soiling and mismatch uncertainties 1.0 %
Degradation uncertainty 1.0 %

Annual production probability

Variability	3.40 MWh
P50	97.06 MWh
P90	92.70 MWh
P95	91.48 MWh

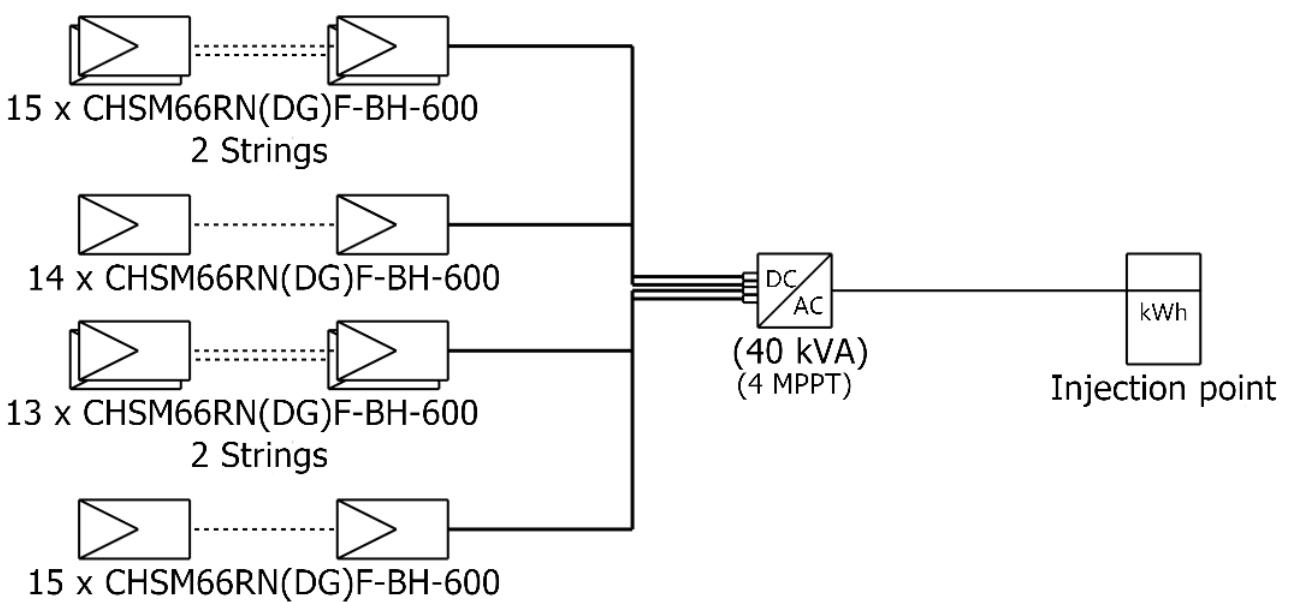
Probability distribution



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Single-line diagram



PV module	CHSM66RN(DG)F-BH-600
Inverter	SUN2000-40KTL-M3-400V
String 1	15 x CHSM66RN(DG)F-BH-600
String 2	14 x CHSM66RN(DG)F-BH-600
String 3	13 x CHSM66RN(DG)F-BH-600

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